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Frailty prevalence and related factors in the older adult—*FrailTURK Project*

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Abstract Frailty is one of the geriatric syndromes and has an important relationship with mortality and morbidity. The aim of this study is to present the characteristics, prevalence, and related factors of frailty in older adults in our country. The study included 1126 individuals over 65 years of age from 13 centers. Frailty was evaluated using the Fried Frailty criteria, and patients were grouped as "frail," "pre-frail," and "non-frail." Nutritional status was assessed with "Mini Nutritional Test," psychological status with the "Center for Epidemiological Studies Depression Scale-CES-D," and additional diseases with the "Charlson Comorbidity index." Approximately 66.5 % of the participants were between 65 and 74 years of age and 65.7 % were

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women. Some 39.2 and 43.3 % of the participants were rated as frail and pre-frail, respectively. The multinomial logistic regression analysis was used to determine the factors associated with frailty. It was observed that age, female gender, low education level, being a housewife, living with the family, being sedentary, presence of an additional disease, using 4 or more drugs/day, avoiding to go outside, at least one visit to any emergency department within the past year, hospitalization within the past year, non-functional ambulation, and malnutrition increased the risk of frailty ($p<0.05$). Establishing the factors associated with frailty is highly important for both clinical practice and national economy. This is the first study on this subject in our country and will provide guidance in determining treatment strategies.

Keywords Older adults · Advanced age · Frailty · Geriatric syndromes

Introduction

Frailty is a medical condition commonly defined as a multidimensional geriatric syndrome with the components of loss of reserves in energy, physical ability, cognition, and health, which give rise to vulnerability (Rockwood et al. 2005; González-Vaca et al. 2014). It is accepted as a clinical concept of observable physical and functional decline in the body associated with physiological changes during later life (Walston et al. 2002). Frailty manifests as an age-related "increased biological vulnerability to stressors" in "susceptible individuals" and leads to adverse health outcomes and ultimately death.

Frailty phenotype was first mentioned by Fried and colleagues and defined as a clinical syndrome in which three or more of the following criteria are present: unintentional weight loss (10 lbs in the last 1 year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity. It is very important for our clinical practice that this frailty phenotype is independently predictive (over 3 years) of falls, worsening of mobility or activities of daily life, disability, hospitalization, and death. Additionally, some previous research results point out the association of frailty with comorbidity (Wong et al. 2010; Heuberger 2011; Jürschik et al. 2012). However, this association has not been considered adequately in the literature probably because the pathogenesis has not been fully discerned.

Fried's criteria were tested for frailty and validated in the Cardiovascular Health Study conducted with 5317 community-dwelling US residents aged 65 or more (Fried et al. 2001). Although there have been attempts to define some different criteria since then, there is consensus on the validity of Fried's frailty criteria in many countries worldwide. This agreement provides an opportunity to standardize frailty studies and to adopt preventive and therapeutic measures to minimize frailty and its avoidable outcomes (Castell et al. 2013). However, because this difference is based mainly on the different criteria and definitions used in the studies, the prevalence of frailty varies widely from one research population to another (Alvarado et al. 2008; Santos-Eggimann et al. 2009; Collard et al. 2012; Gale et al. 2015). The prevalence of frailty has been reported in a wide range of values from 4 to 59.1 % in previous studies. The difference between countries was also noted (Collard et al. 2012). If we take into account the large frailty prevalence ratios, prevention seems to be far more cost-effective than treatment and should be considered as the first line of defense. Screening and early intervention against frailty itself and its correlated factors must be the key concern (Bandeen-Roche et al. 2006; Xue et al. 2008). Today, both national and international medical literature lack frailty data on the Turkish older adult population. Such data is obviously very important to be able to take preventive measures in our country in terms of both health and economy.

The aim of this study is to present the characteristics, prevalence, and related factors of frailty in the older adults in our country.

Materials and methods

Study population

The present study was designed as a cross-sectional, multicenter study. The study included the male and female patients 65 years of age and older who presented to the Physical Medicine and Rehabilitation (PMR) outpatient clinics at 13 centers located in various regions of Turkey between December 2012 and June 2013. The university and training hospital centers included in the study were chosen in a manner to reflect the overall characteristics of Turkish older adult population. Each

of these centers was meant to represent different geographic regions of Turkey. The study was organized by the Turkish Society of Physical Medicine and Rehabilitation, Geriatric Rehabilitation Research Group. As in similar multi-centered studies, the ethics committee approval was obtained for this study from a single site in the name of all sites. The local ethics committees were informed that the ethics committee approval had been obtained for the study. All the patients who volunteered to participate in the study signed an informed consent. All procedures were carried out in line with good clinical practices.

Patients with aphasia, dementia, and cognitive problems, those who could not take the tests for Fried's criteria, those who did not wish to participate, and those with whom communication was impossible were excluded from the study. Their demographic data and socioeconomic information concerning occupation, education level, annual income, geographical region, place of residence, and marital status were recorded. Their medical histories including comorbid diseases, visual and auditory loss, urinary incontinence, polypharmacy, and smoking habits were questioned. Their visits to the emergency service, hospitalization, and falling history during the last 1 year were inquired and some specific questions were asked to find out their activity levels and ambulation needs. The researchers from all the centers were asked to observe whether their patients experienced any self-neglect, and all patients were asked questions in order to evaluate their health status.

The questionnaires were completed by the physical and rehabilitation physicians at the sites. In order to standardize the completion of questionnaires and the testing procedures across the sites, guidelines describing in detail patient characteristics (inclusion/exclusion criteria) and testing procedures were sent to the sites after the questionnaires had been prepared. After pilot patient recruitments were made at the sites, care was taken to resolve any questions and ambiguities forwarded from the sites. A common language and a standard procedure were established by sending the answers to frequently asked questions to all the sites.

Frailty criteria

Frailty information was derived from Fried's frailty criteria categorizing older adults as non frail with no criterion, pre-frail with one or two criteria and as frail with at least three criteria (Fried et al. 2001). Fried's frailty criterion with five domains is the most extensively tested instrument for its validity and is the most widely used one in frailty researches (Bouillon et al. 2013):

- Criteria 1 was involuntary weight loss of 4.5 kg or more or detriment of at least 5 % of total body weight during the last year.
- Criteria 2 was grip strength measured by Jamar® hand dynamometer. While the patient was sitting in the chair with the shoulder adducted, the elbow flexed to 90° and the forearm in neutral position, the place of the hydraulic dynamometer was fixed to position 2 for women and to position 3 for men. The arithmetic mean of three sequential measurements made in one-minute intervals was recorded and all measurements were adjusted for gender and body mass index (BMI). The criteria were accepted as met showing weakness for women if the strength was ≤17 kg for BMI of ≤23, ≤17.3 kg for BMI between 23.1 and 26, ≤18 kg for BMI between 26.1 and 29, and ≤21 kg for BMI of >29. For men, the adjusted values were ≤29 kg for BMI of ≤24, ≤30 kg for BMI between 24.1 and 26, 30 kg for BMI between 26.1 and 28, and ≤32 kg for BMI of >28 (Heuberger 2011).
- Criteria 3 was self-reported exhaustion and was evaluated via two questions (questions 7 and 20) from the Center for Epidemiologic Studies Depression (CES-D) scale which included 20 questions in total (Radloff 1977).

For the statements of "I feel that everything I did was an effort" and "I did not feel like doing anything" the patient was asked to answer the question "How often have you felt this way in the past week?." The patient rated the answer on a scale of 0=rarely or none of the time (less than 1 day), 1=some or a little of the time (1–2 days), 2=occasionally or a moderate amount of the time (3–4 days), and 3=most or all of the time (5–7 days of the last week). A score of 2 or 3 from one or both of these two questions were sufficient to indicate frailty.

- Criteria 4 was slow walking speed. It was also adjusted for gender as well as the height of the patient regardless of whether a walking aid was used or not. For men with a height of ≤173 cm≥7 s of walking to a distance of 4.57 m, and for men with a height of >173 cm≥6 s were assumed as slow speed

and positive criterion. For women, slow speed was ≥7 s for those with a height of ≤159 cm and ≥6 s for those with a height of >159 cm.
- Criteria 5 was low physical activity level. Absence of loading activity in the last 3 months, sitting for more than 4 h a day, 1 or less monthly activity of short walking (total energy consumption: <383 kcal/week for men, 270 kcal/week for women) (Cesari et al. 2006).

Comorbidity index

The Charlson comorbidity index consists of 17 comorbid situations found to be associated with annual mortality. Charlson et al. invented a weighted score for each comorbid condition based on the relative risk of annual mortality to obtain the disease burden. After validating the index in breast cancer patients, Charlson et al. reported that the score as an indicator of disease burden also had a strong ability to predict mortality. Since 1987 the index has been validated for its ability to predict mortality in various disease subgroups. Therefore, the Charlson index is considered a valid prognostic indicator for mortality. It gives percent value for 1-year mortality risk as well as an index score. Total maximum score is 37 with a minimum score of 3 indicating comorbidity (Charlson et al. 1987).

Other instruments used for obtaining data

- Holden Functional Ambulation Scale provides information on whether a patient is independent from ambulation. The system categorizes patients according to their basic motor skills necessary for functional ambulation, without assessing the factor of endurance. It starts from "category-1" as "nonfunctional ambulator patient" requiring more than one person for supervision or physical assistance and goes up to "category-6" as "ambulator" describing a patient ambulating independently on uneven and level surfaces, stairs, and inclines (Holden et al. 1986).
- Mini Nutritional Assessment (MNA) tool has been designed for easy use by health professionals in hospitals and nursing homes. The test comprises of simple anthropomorphic measurements and a brief questionnaire. It includes four domains: (a) anthropometric assessment (BMI and weight loss), (b) general assessment (lifestyle, medication, disease history of last 3 months and mobility), (c) dietary assessment (number of meals, food, and fluid intake, loss of appetite, and autonomy of eating), and (d) self assessment (self-perception of nutrition and health). The MNA tool has already been validated for clinical evaluation and comprehensive nutritional assessment. It classifies older adults as well-nourished with at least 24 points, at risk of malnutrition with points between 17 and 23.5 and undernourished with a point less than 17 out of 30 points. Most important aspect of this tool is its ability to identify the older adults at risk for malnutrition, with scores between 17 and 23.5, before severe changes in weight or albumin levels occur (Vellas et al. 1999).
- CES-D scale is a questionnaire composed of 20 items, each of which is graded from zero (less than 1 day of the last week) to 3 (5–7 days of the last week). A score of 16 or more indicates depression (Radloff 1977).

Statistical analysis

Calculations were made using the SPSS IBM 21.0 software. A chi-square analysis was performed for intergroup sociodemographic and categorization data. Compliance of numeric data with the normal distribution was evaluated by the Shapiro test. A one-way variance analysis was performed for the data complying with the normal distribution. The Bonferronni analysis was used for binary analyses. Data outside normal distribution were assessed by the Kruskal-Wallis test. The Mann–Whitney U test was used for the binary analysis of variable data. The odds ratio (OR) for significant values was calculated by using the multinomial logistic regression analysis. Later, a multiple regression analysis was performed based on the Forward Likelihood Ratio. In all hypotheses, a significance level of $\alpha=0.05$ was used, and a confidence interval of 95 % was accepted for statistical significance ($p<0.05$).

Results

The data of 1200 patients from 13 centers were obtained. Seventy patients with incomplete files, that could affect the study result, and four patients who met the

exclusion criteria were excluded from the study. The data of 1.126 patients were included in the study. Approximately 66.5 % of the participants were between 65 and 74 years of age and 65.7 % were women. The ratio of participants rated as frail and pre-frail was 39.2 and 43.3 %, respectively. The sociodemographic and clinical characteristics of the subjects are given in Tables 1, 2, and 3.

When pre-frail, frail and non-frail older adult subjects were compared in terms of their sociodemographic characteristics, a statistically significant difference was found between the three groups with respect to the parameters of age, female gender, marital status, literacy, being a housewife, number of children, annual income, and living in a nursing home ($p<0.05$). There was no significant difference between the three groups in terms of living alone and place of residence ($p>0.05$) (Table 1).

When pre-frail, frail, and non-frail older adult subjects were compared in terms of their clinical characteristics, a statistically significant difference was found between the three groups with respect to being

Table 1 Comparison of the demographic characteristics of the elderly participants in terms of frailty

	Frailty			*p* value
	Frail	Pre-frail	Non-frail	
Age (%)				
65–74	230 (31.2)	345 (46.8)	162 (22.0)	<0.001
75–84	187 (53.4)	131 (37.4)	32 (9.1)	
>85	24 (61.5)	12 (30.8)	3 (7.7)	
Gender (%)				
Men	112 (29.0)	183 (47.4)	91 (23.6)	<0.001
Women	329 (44.5)	305 (41.2)	106 (14.3)	
Marital status (%)				
Married	245 (34.3)	327 (45.8)	142 (19.9)	0.001
Widow	187 (47.9)	150 (38.5)	53 (13.6)	
Divorced	5 (38.5)	7 (53.8)	1 (7.7)	
Single	4 (44.4)	4 (44.4)	1 (11.1)	
Education (%)				
University	10 (15.6)	30 (46.9)	24 (37.5)	<0.001
High School	49 (34.3)	61 (42.7)	33 (23.1)	
Primary-secondary school	212 (37.2)	249 (43.7)	109 (19.1)	
Illiterate	170 (48.7)	148 (42.4)	31 (8.9)	
Occupation (%)				
Retired	157 (32.3)	223 (45.9)	106 (21.8)	<0.001
Housewife	262 (45.7)	238 (41.5)	73 (12.7)	
Civil servant	1 (16.7)	2 (33.3)	3 (50.0)	
Worker	1 (11.1)	5 (55.6)	3 (33.3)	
Other	20 (38.5)	20 (38.5)	12 (23.1)	
Place of residence (%)				
Own house	340 (37.1)	405 (44.2)	171 (18.7)	0.005
Nursing home	11 (73.3)	2 (13.3)	2 (13.3)	
With family	89 (45.9)	81 (41.8)	24 (12.4)	
Living alone (%)				
Yes	102 (44.0)	94 (40.5)	36 (15.5)	0.233
No	339 (37.9)	394 (44.1)	161 (18.0)	
Place of residence (%)				
City	326 (38.1)	381 (44.5)	149 (17.4)	0.331
Country	115 (42.6)	107 (39.6)	48 (17.8)	

Table 2 Comparison of clinical characteristics in terms of frailty

	Frailty			*p* value
	Frail	Pre-frail	Non-frail	
Activity (%)				
Sedentary	314 (53.7)	222(37.9)	49 (8.4)	<0.001
Recreational walking	112 (26.8)	219(52.4)	87(20.8)	
Regular walking	15 (12.8)	45 (38.5)	57(48.7)	
Athletic	0 (0.0)	2 (33.3)	4 (66.7)	
Health insurance (%)				
Yes	412 (38.5)	470 (43.9)	189 (17.6)	0.105
No	29 (52.7)	18 (32.7)	8 (14.5)	
Use of ≥4 drugs (%)				
Yes	292 (52.3)	208 (37.3)	58 (10.4)	<0.001
No	149 (26.2)	280 (49.3)	139 (24.5)	
Smoking (%)				
Yes	21 (22.8)	42 (45.7)	29 (31.5)	<0.001
No	347 (42.6)	342 (42.0)	126 (15.5)	
Quit	73 (33.3)	104 (47.5)	42 (19.2)	
Presence of additional disease (%)				
Yes	424 (41.5)	436 (42.7)	161 (15.8)	<0.001
No	17 (16.2)	52 (49.5)	36 (34.3)	
Visual problems (%)				
Yes	245 (42.1)	260 (44.7)	77 (13.2)	<0.001
No	196 (36.0)	228 (41.9)	120 (22.1)	
Hearing problems (%)				
Yes	200 (49.4)	166 (41.0)	39 (9.6)	<0.001
No	241 (33.4)	322 (44.7)	158 (21.9)	
Urinary incontinence (%)				
Yes	193 (55.1)	125 (35.7)	32 (9.1)	<0.001
No	248 (32.0)	363 (46.8)	165 (21.3)	
Admission to emergency service (%)				
Yes	227 (60.2)	122 (32.4)	28 (7.4)	<0.001
No	214 (28.6)	366 (48.9)	169 (22.6)	
Hospitalization (%)				
Yes	237 (56.6)	144 (34.4)	38 (9.1)	<0.001
No	204 (28.9)	344 (48.7)	159 (22.5)	
Avoiding to go outside (%)				
Yes	226 (66.7)	99 (29.2)	14 (4.1)	<0.001
No	215 (27.3)	389 (49.4)	183 (23.3)	
History of falls (%)				
Yes	170 (56.5)	107 (35.5)	24 (8.0)	<0.001
No	271 (32.8)	381 (46.2)	173 (21.0)	
Insomnia (%)				
Yes	288 (48.5)	236 (39.7)	70 (11.8)	<0.001
No	153 (28.8)	252 (47.4)	127 (23.9)	
Ambulation (%)				
Independent	158 (21.7)	388 (53.3)	182 (25.0)	<0.001
Walking stick	195 (64.8)	92 (30.6)	14 (4.7)	
Walker	29 (87.9)	4 (12.1)	0 (0.0)	
Wheelchair	59 (92.2)	4 (6.3)	1 (1.6)	

Table 2 (continued)

	Frailty			*p* value
	Frail	Pre-frail	Non-frail	
Musculoskeletal pain (%)				
Yes	402 (41.0)	419 (42.8)	159 (16.2)	0.001
No	39 (26.7)	69 (47.3)	38 (26.0)	
Fatigue (%)				
Yes	372 (45.9)	351 (43.3)	87 (10.7)	<0.001
No	69 (21.8)	137 (43.4)	110 (34.8)	
Shopping (%)				
Alone	128 (21.7)	312 (53.0)	149 (25.3)	<0.001
With help from the family	277 (56.6)	167 (34.2)	45 (9.2)	
Support service	20 (76.9)	5 (19.2)	1 (3.8)	
Other	16 (72.7)	4 (18.2)	2 (9.1)	
Self-neglect (%)				
Yes	148 (62.4)	74 (31.2)	15 (6.3)	<0.001
No	293 (33.0)	414 (46.6)	182 (20.5)	
Perception of health (%)				
Very poor	34 (85.0)	6 (15.0)	0 (0.0)	<0.001
Poor	131 (69.3)	52 (27.5)	6 (3.2)	
Average	195 (43.9)	205 (46.2)	44 (9.9)	
Good	74 (19.0)	203 (52.2)	112 (28.8)	
Very good	7 (10.9)	22 (34.4)	35 (54.7)	
Holden ambulation scale (%)				
Non-functional	38 (92.7)	2 (4.9)	1 (2.4)	<0.001
Support from ≥1 person	19 (100.0)	0 (0.0)	0(0.0)	
Support from 1 person	37 (90.2)	3 (7.3)	1 (2.4)	
Support on surface level	128 (74.9)	41 (24.0)	2 (1.2)	
Support on stairs	90 (49.5)	82 (45.1)	10 (5.5)	
Independent	129 (19.2)	360 (53.6)	183 (27.2)	
Nutrition status %				
Good	198 (26.2)	380 (50.3)	178 (23.5)	<0.001
At risk	189 (61.0)	103 (33.2)	18 (5.8)	
Malnutrition	54 (90.0)	5 (8.3)	1 (1.7)	

sedentary, use of four or more drugs, number of drugs used, smoking status, presence of an additional disease, number of additional diseases, vision and hearing loss, incontinence, history of hospitalization and at least one admission to an emergency service within the last 1 year, avoiding to go outside, history of falls within the last 1 year, sleeping problems, fatigue, self-neglect, nutrition score, CES-D score, Charlson score, Charlson comorbidity index, and poor perception of health ($p<0.05$). There was no significant difference between the presence and absence of health insurance in terms of frailty ($p=0.105$). Subjects who could walk and do their shopping independently had significantly low frailty levels ($p<0.05$). According to the Holden functional ambulation scale, frailty was found to be significantly low in subjects who ambulated independently and in those with good nutrition status ($p<0.05$).

Multinomial logistic regression analysis was used to determine the factors associated with frailty. It was observed that age, female gender, low education level, being a housewife, living with the family, being sedentary, presence of additional disease, use of 4 or more drugs, avoiding to go outside, non-functional ambulation and malnutrition increased the risk of frailty ($p<0.05$). It was also found that the risk of frailty increased significantly

Table 3 Patient characteristics by frailty subgroups

	Frailty		
	Frail	Pre-frail	Non-frail
Number of children (mean±SD)*	4.03±2.04	3.73±2.04	3.4±1.96
Height (mean±SD)			
Men	168.4±6.857	168.9±6.033	168.44±7.305
Women	156.96±6.218	157.29±6.281	158.02±5.638
Total	159.86±8.097	161.65±8.363	162.83±8.286
Weight (mean±SD)			
Men	75.3±11.64	75.45±11.148	73.44±10.491
Women	72.44±12.017	71.72±12.315	69.42±10.037
Total	73.17±11.974	73.12±12.016	71.27±10.419
BMI (mean±SD)			
Men	26.57±3.89	26.39±3.28	25.87±3.23
Women	29.43±4.80	29.01±4.88	27.88±4.41
Total	28.70±4.75	28.03±4.53	26.95±4.03
Number of drugs used (mean±SD)*	4.62±2.74	3.31±2.32	2.5±1.99
Number of diseases (mean±SD)*	3.18±1.72	2.08±1.36	1.78±1.25
Annual income $ (mean±SD)*	5231.1±5240.9	5754.4±5363.9	6171.9±5038. 3
Nutrition score (mean±SD)*	22.38±4.59	25.81±2.93	27.06±2.23
CES-D score (mean±SD)*	20.55±9.44	15.48±7.78	13.52±7.20
Charlson score (mean±SD)*	2.01±1.83	1.20±1.51	0.89±1.29
Charlson index % (mean±SD)*	33.94±20.94	25.30±16.50	21.34±12.54

SD standard deviation

*$p<0.05$

with the rise in CES-D score, Charlson score, and Charlson comorbidity index ($p<0.05$) (Tables 4, 5, and 6). Fatigue that increased the risk of frailty was observed to have lost its statistical significance in the multiple analysis ($p>0.05$). Similarly, the risk of frailty was high in the single analysis in subjects with malnutrition, whereas its statistical significance decreased in multiple analysis ($p>0.05$) (Tables 4, 5, and 6).

Hosmer–Lemeshow test with 8 degrees of freedom showed a significance value of $p=0.637$. All of these variables were significant in single analyses. Hence, none of them showed a poor fit (Table 5). In goodness-of-fit test, the significance values of Pearson's chi-square test and Deviance chi-square test were $p=0.701$ and $p=1$, respectively. In Pseudo-R^2 calculations which show the explanatory power of the model, the significance values for Cox and Snell and Nagelkerke were 0.435 and 0.498, respectively. With respect to frailty ($n=441$), the sensitivity and specificity of the model was found as 91.2 % (402/441) and 80.2 % (158/197), respectively.

Discussion

It is very important for our clinical practice that frailty is independently predictive of fall incidents, comorbidities, worsening of mobility or activities of daily life, hospitalization, and death (Fairhal et al. 2008; Wong et al. 2010; Heuberger 2011; Jürschik et al. 2012; Runzer-Colmenares et al. 2014). At the end of our study, as many as 39.2 and 43.3 % of the older adult participants were found frail and pre-frail, respectively. It was observed that the determining factors associated with frailty included age, female gender, low education level, being sedentary, presence of an additional disease, use of four or more drugs, admission to emergency service in the last 1 year, hospitalization in the last 1 year, ambulation status, and risk of malnutrition.

In the literature, the prevalence of frailty among older adults has been reported in a wide range of values from 4 to 59.1 %. While a population-based study conducted in Latin America and the Caribbean showed a frailty prevalence of 26.7 % in Barbados, the prevalence in Chile was 42.6 % (Alvarado et al. 2008). For the Survey of Health, Aging, and Retirement in Europe (SHARE),

Table 4 Analysis of frailty risk based on depression, nutrition, and comorbidity scores

Clinical characteristics	*B*	Std. error	OR	95 % confidence interval		*P* value
				Lower bound	Upper bound	
Nutrition score	−0448	0.039	0.639	0.592	0.690	<0.001
CES-D score	0.101	0.011	1.106	1.081	1.131	<0.001
Charlson score	0.498	0.074	1.645	1.422	1.903	<0.001
Charlson comorbidity index	0.046	0.007	1.047	1.033	1.061	<0.001

16.584 men and women aged 50 and older were examined excluding the UK data and the prevalence of frailty was found as 17 % among those aged 65 and older, with an obvious excess of frailty among women (Santos-Eggimann et al. 2009). Using Fried's frailty phenotype, the prevalence values reported for individual countries were 9.6–27.3 % for Spain, 23 % for Italy, and 14 % for Greece (Santos-Eggimann et al. 2009; Jürschik et al. 2012; Castell et al. 2013). In our study, the prevalence of frailty was found as 39.2 %. These variances can be explained by the differences in the criteria and definitions used. Other important factors noted include the differences in countries and geographical features (Collard et al. 2012; Hoover et al. 2013). The fact that our study included subjects who applied to the hospital may account for the higher frailty prevalence compared with that found in European countries. Our Asian origin and genetic characteristics may also be a factor in this difference. Additionally, frailty prevention approaches or social awareness on this issue being less common in our country may have played a role in this difference. Future studies will provide us with more precise information about this difference.

Studies performed so far have tried to establish the sociodemographic and clinical factors associated with frailty. The objective of these studies was to determine frailty-related factors and protective strategies (Morley et al. 2013). In our study the sociodemographic factors associated with frailty were identified as age, female gender, low education status (literate), being a housewife, and living with the family. In the literature, especially age and female gender stand out as determining

Table 5 Factors affecting frailty based on multiple regression analysis

	B	Std. error	OR	95 % confidence interval		*p* value
				Lower bound	Upper bound	
CES-D score	0.059	0.015	1.061	1.031	1.092	<0.001
Holden Ambulation Scale (non-functional)	2.607	1.140	13.554	1.452	126.515	0.022
Holden Ambulation Scale (ambulatory with the support of ≥1 person)	3.004	1.136	20.157	2.177	186.675	0.008
Holden Ambulation Scale (support on surface level)	3.737	0.748	41.992	9.699	181.807	<0.001
Holden Ambulation Scale (support in climbing stairs)	1.668	0.378	5.300	2.526	11.118	<0.001
Fatigue	0.471	0.250	1.602	0.981	2.613	0.059
Use of ≥4 drugs	0.698	0.234	2.010	1.272	3.177	0.003
Gender	0.751	0.242	2.120	1.319	3.406	0.002
Sedentary	2.475	0.401	11.880	5.415	26.065	<0.001
Recreational walking	1.477	0.397	4.378	2.010	9.536	<0.001
Hearing problems	0.684	0.252	1.983	1.211	3.247	0.007
Admission to emergency service	1.001	0.281	2.720	1.568	4.719	<0.001
Malnutrition	0.546	1.137	1.726	0.186	16.041	0.631
Malnutrition risk	1.184	0.314	3.267	1.764	6.048	<0.001

Hosmer–Lemeshow test $df=8$, $p=0.637$

Table 6 Single regression analysis results of the parameters that increase the risk for frailty

Clinical characteristics	Std. error	OR	95 % confidence interval		*p* value
			Lower bound	Upper bound	
Age (>85 and over)	0.621	5.635	1.669	19.028	0.005
Age (between 74–85)	0.217	4.116	2.690	6.299	<0.001
Gender	0.180	2.522	1.772	3.588	<0.001
Education (illiterate)	0.424	13.161	5.733	30.216	<0.001
Education (primary and secondary school)	0.394	4.668	2.155	10.112	<0.001
Education (high school)	0.439	3.564	1.509	8.419	0.004
Occupation (housewife)	0.388	2.153	1.006	4.610	0.048
Place of residence (family)	0.248	1.865	1.146	3.035	0.012
Activity (sedentary)	0.327	26.060	13.740	49.426	<0.001
Activity (recreational walking)	0.322	5.235	2.787	9.835	<0.001
Use of ≥4 drugs	0.186	4.697	3.262	6.762	<0.001
Presence of additional disease	0.308	5.577	3.046	10.209	<0.001
Visual problems	0.175	1.948	1.383	2.743	<0.001
Hearing problems	1.213	3.362	2.259	5.003	<0.001
Urine incontinence	0.216	4.013	2.629	6.124	<0.001
Admission to emergency service	0.225	6.402	4.118	9.955	<0.001
Hospitalization	0.204	4.861	3.257	7.254	<0.001
Avoiding to go outside	0.293	13.740	7.734	24.410	<0.001
Falls	0.239	4.522	2.832	7.221	<0.001
Insomnia	0.179	3.415	2.403	4.854	<0.001
Walking support (wheelchair)	1.014	67.962	9.309	496.166	<0.001
Walking support (walking stick)	0.297	16.044	8.959	28.732	<0.001
Musculoskeletal pain	0.246	2.463	1.520	3.993	<0.001
Fatigue	0.194	6.817	4.657	9.977	<0.001
Self-neglect	0.287	6.129	3.492	10.755	<0.001
Holden Ambulation Scale (non-functional)	1.020	53.907	7.308	397.657	<0.001
Holden Ambulation Scale (ambulatory with the support of ≥1 person)	1.015	79.442	10.857	581.266	<0.001
Holden Ambulation Scale (support on surface level)	0.722	90.791	22.061	373.644	<0.001
Holden Ambulation Scale (support in climbing stairs)	0.353	12.767	6.397	25.482	<0.001
Malnutrition	1.014	48.545	6.647	354.554	<0.001
Malnutrition risk	0.267	9.439	5.589	15.943	<0.001

CI confidence interval, *OR* odds ratio

factors in frailty (Heuberger 2011; Jürschik et al. 2012; Castell et al. 2013; Hoover et al. 2013; Kobayashi et al. 2013; Moreira and Lourenço 2013; González-Vaca et al. 2014; Runzer-Colmenares et al. 2014). On the other hand, Oliveira et al. (2013) did not report age and female gender as influential factors. As in many studies, we also observed in our study that women were being affected by the condition predominantly (Jürschik et al. 2012; Moreira and Lourenço 2013; Oliveira et al. 2013; González-Vaca et al. 2014; Gale et al. 2015). However, it seems difficult to explain this result with the findings of our study. Being married was reported as a risk factor in one study (Runzer-Colmenares et al. 2014), while being divorced (Jürschik et al. 2012; Castell et al. 2013; Moreira and Lourenço 2013) and living alone (Heuberger 2011; Jürschik et al. 2012; Oliveira et al. 2013) were noted as risk factors in other studies. Social isolation, lack of care and attention, and financial factors may be effective with regard to the significance of the relationship between living alone and frailty (Heuberger

2011). Similar to other studies (Heuberger 2011; Castell et al. 2013; Moreira and Lourenço 2013), but with a few exceptions (Oliveira et al. 2013; Joosten et al. 2014), education level of the older adults appeared to be an effective factor in our study. Regarding health care, health behaviors, self-efficacy, childhood, circumstances and income; low education level and low socioeconomic status are thought to be a risk factor for frailty (Heuberger 2011; Jürschik et al. 2012; Castell et al. 2013).

When lifestyle and clinical characteristics are considered, we found in our study that being sedentary, avoiding going outside and ambulation status were the determining clinical factors for frailty. Similar to the results presented in the literature, we also found that frailty rates were significantly lower in subjects who could walk and do their shopping independently (Heuberger 2011; Moreira and Lourenço 2013; González-Vaca et al. 2014). Exercise is reported to be an important factor for frailty, and this finding is important in terms of establishing protective approaches (Fairhal et al. 2008; Heuberger 2011). Findings regarding functional status, weakness, and exhaustion in the older adults are important and may provide us with guidance for preventing frailty, as well as for early diagnosis (Bandeen-Roche et al. 2006; Xue et al. 2008). The results of our study show that action should be taken to raise awareness in the society with respect to these risk factors.

Unlike the studies in the literature, our study did not reveal any significant relationship between frailty and the presence of health insurance or poor perception of health (Heuberger 2011; Jürschik et al. 2012; Castell et al. 2013; Moreira and Lourenço 2013). Sociocultural characteristics and close family relationships in our country might have played a role in this difference. The relationship between frailty, depression, and malnutrition reported in the literature was also observed in our study (Heuberger 2011; Jürschik et al. 2012; Kobayashi et al. 2013; González-Vaca et al. 2014). Encouraging older adults to exercise, providing them with an awareness of appropriate nutrition habits, and recognizing the signs of depression in older adults stand out as important points to be observed in clinical practice.

Moreover, dysregulation of many systems results in a "critical mass" that induces frailty (Heuberger 2011; Jürschik et al. 2012; Castell et al. 2013; González-Vaca et al. 2014). In line with the literature, we found in our study a relationship between frailty and the presence of an additional disease, vision loss, hearing loss, incontinence, fatigue, neglect, admission to emergency service in the last 1 year, history of hospitalization, insomnia, and a high Charlson score (Jürschik et al. 2012; Castell et al. 2013; Kobayashi et al. 2013; Moreira and Lourenço 2013; González-Vaca et al. 2014; Joosten et al. 2014). It is obvious that there is a need for studies that would reveal the pathophysiology behind the relationships between frailty and clinical condition, symptoms, diseases, and disability. It is also noted in the literature that frailty increases the risk of falls (OR: 2.4) and fractures (OR: 1.7) (Jürschik et al. 2012; Runzer-Colmenares et al. 2014). A relationship between frailty and history of falls was observed also in our study. Joosten et al. (2014), on the other hand, did not find such relationship in their study. Fear of falling is one of the important problems experienced by older adults and is also related to frailty as shown in our study. Older adults avoid going outside for the fear of falling, and this fear affects their daily activities and functional capacity, increasing the risk of frailty (Heuberger 2011). Similar to other studies, the relationship between frailty and the use of 4 or more drugs became evident in our study in the multiple regression analyses (Jürschik et al. 2012; Castell et al. 2013). It is, therefore, important to inform health professionals and the public about the impact of using 4 or more drugs in older people on their frailty. Effective treatment of additional diseases, prevention of falls, regulation of drug use, and prevention of disability may contribute to the success of the treatment of frailty.

The strong aspects of our study may be listed as the large study population consisting of many subjects from 13 different centers in diverse geographical regions of Turkey, their multidimensional assessments, and the fact that our study is the first to provide data on this subject in our country.

The limitations of our study include the selection of older adult subjects among those who presented to outpatient clinics, its cross-sectional structure rather than being a follow-up study, lack of follow-up for mortality, pre-frail people not having been followed up for becoming frail, lack of data as to how many patients have been screened in each site, and lack of an assessment of laboratory values due to the high number of subjects. Furthermore, since patients older than 65 years who presented as outpatients for physiotherapy were included in the study, it will certainly be difficult to

comment on the rates for the general public. However, it should also be noted that it would be difficult to find the possibility to assess patients in such a multidimensional way (physical, psychological, nutritional, physical examination) in a future study where sampling is made from the society.

In conclusion, establishing frailty prevalence and its related factors is undoubtedly important for both clinical practice and national economy. According to our study results, the prevalence of frailty was found to be 39.2 % and age, gender, education, activity status, comorbidity, nutrition, and polypharmacy use were found correlated to frailty. Although it would not be possible to change sociodemographic characteristics of older people to improve their frailty, effective treatment of their comorbidities, encouraging them to lead an active life with exercise, and regulating their drug use and nutrition are important for our clinical practice. Screening the older adult population for frailty, determining protective strategies, and forming multidisciplinary teams will be among the objectives of future studies. We believe that our study provides a significant source and guidance for establishing these strategies in the future.

Conflict of interest We have not a financial relationship for this research and no conflicts of interest for any of the authors.

Author's contributions Eyigor S is responsible for conception and design, acquisition of data, analysis and interpretation of data, drafting the article and revising, and final approval of the version. Kutsal YG is responsible for conception and design, acquisition of data, revising, and final approval of the version. Duran E is responsible for acquisition of data, analysis and interpretation of data, and final approval of the version. Huner B is responsible for acquisition of data, analysis and interpretation of data, drafting the article, and final approval of the version. Paker N is responsible for conception and design, acquisition of data, and final approval of the version. Durmus B is responsible for acquisition of data and final approval of the version. Sahin N is responsible for acquisition of data and final approval of the version. Civelek GM is responsible for acquisition of data and final approval of the version. Gokkaya K is responsible for acquisition of data and final approval of the version. Doğan A is responsible for acquisition of data and final approval of the version. Günaydın R is responsible for acquisition of data and final approval of the version. Toraman F is responsible for acquisition of data and final approval of the version. Cakir T is responsible for acquisition of data and final approval of the version. Evcik D is responsible for acquisition of data and final approval of the version. Aydeniz A is responsible for acquisition of data and final approval of the version. Yildirim AG is responsible for acquisition of data and final approval of the version. Borman P is responsible for acquisition of data and final approval of the version. Okumus M is responsible for acquisition of data and final approval of the version. Ceceli E is responsible for acquisition of data and final approval of the version to be published.

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References

Alvarado BE, Zunzunegui MV, Béland F, Bamvita JM (2008) Life course social and health conditions linked to frailty in Latin American older men and women. J Gerontol A: Biol Med Sci 63:1399–1406

Bandeen-Roche K, Xue QL, Ferrucci L, Walston J, Guralnik JM, Chaves P, Zeger SL, Fried LP (2006) Phenotype of frailty: characterization in the women's health and aging studies. J Gerontol A: Biol Med Sci 61:262–266

Bouillon K, Kivimaki M, Hamer M, Sabia S, Fransson EI, Singh-Manoux A et al (2013) Measures of frailty in population-based studies: an overview. BMC Geriatr 13:64

Castell MV, Sánchez M, Julián R, Queipo R, Martín S, Otero A (2013) Frailty prevalence and slow walking speed in persons age 65 and older: implications for primary care. BMC Fam Pract 14:86

Cesari M, Leeuwenburgh C, Lauretani F, Onder G, Bandinelli S, Maraldi C, Guralnik JM, Pahor M, Ferrucci L (2006) Frailty syndrome and skeletal muscle: results from the Invecchiare in Chianti study. Am J Clin Nutr 83:1142–1148

Charlson ME, Pompei P, Ales KL, MacKenzie CR (1987) A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chron Dis 40:373–383

Collard RM, Boter H, Schoevers RA, Oude Voshaar RC (2012) Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc 60:1487–1492

Fairhal N, Aggar C, Kurrle SE, Sherrington C, Lord S, Lockwood K et al (2008) Frailty Intervention Trial (FIT). BMC Geriatr 8:27

Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Group CHSCR et al (2001) Frailty in older adults: evidence for a phenotype. J Gerontol A: Biol Med Sci 56:46–56

Gale CR, Cooper C, Sayer AA (2015) Prevalence of frailty and disability: findings from the English Longitudinal Study of Ageing. Age Ageing 44:162–165

González-Vaca J, de la Rica-Escuín M, Silva-Iglesias M, Arjonilla-García MD, Varela-Pérez R, Oliver-Carbonell JL, Abizanda P (2014) Frailty in Institutionalized older adults from Albacete. The final study: rationale, design, methodology, prevalence and attributes. Maturitas 77:78–84

Heuberger RA (2011) The frailty syndrome: a comprehensive review. J Nutr Gerontol Geriatr 30:315–368

Holden MK, Gill KM, Magliozzi MR (1986) Gait assessment for neurologically impaired patients. Standards for outcome assessment. Phys Ther 66:1530–1539

Hoover M, Rotermann M, Sanmartin C, Bernier J (2013) Validation of an index to estimate the prevalence of frailty among community-dwelling seniors. Health Rep 24:10–17

Joosten E, Demuynck M, Detroyer E, Milisen K (2014) Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. BMC Geriatr 14:1

Jürschik P, Nunin C, Botigué T, Escobar MA, Lavedán A, Viladrosa M (2012) Prevalence of frailty and factors associated with frailty in the elderly population of Lleida, Spain: the FRALLE survey. Arch Gerontol Geriatr 55:625–631

Kobayashi S, Asakura K, Suga H, Sasaki S, Three-generation Study of Women on Diets and Health Study Group (2013) High protein intake is associated with low prevalence of frailty among old Japanese women: a multicenter cross-sectional study. Nutr J 12:164

Moreira VG, Lourenço RA (2013) Prevalence and factors associated with frailty in an older population from the city of Rio de Janeiro, Brazil: the FIBRA-RJ Study. Clinics (Sao Paulo) 68: 979–985

Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, Cesari M, Chumlea WC, Doehner W, Evans J, Fried LP, Guralnik JM, Katz PR, Malmstrom TK, McCarter RJ, Gutierrez Robledo LM, Rockwood K, von Haehling S, Vandewoude MF, Walston J (2013) Frailty consensus: a call to action. J Am Med Dir Assoc 14:392–397

Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL (2013) Prevalence of frailty syndrome in old people in a hospital institution. Rev Lat-Am Enfermagem 21: 891–898

Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1: 385–401

Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A (2005) A global clinical measure of fitness and frailty in elderly people. Can Med Assoc J 173: 489–495

Runzer-Colmenares FM, Samper-Ternent R, Al Snih S, Ottenbacher KJ, Parodi JF, Wong R (2014) Prevalence and factors associated with frailty among Peruvian older adults. Arch Gerontol Geriatr 58:69–73

Santos-Eggimann B, Cuenoud P, Spagnoli J, Junod J (2009) Prevalence of frailty in middle- aged and older community-dwelling Europeans living in 10 countries. J Gerontol A: Biol Med Sci 64:675–681

Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S et al (1999) The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition 15:116–122

Walston J, McBurnie M, Newman Tracy RP, Kop WJ, Hirsch CH, Gottdiener J, Fried LP (2002) Frailty and activation of the inflammation and coagulation systems with and without clinical morbidities: results from the Cardiovascular Health Study. Arch Intern Med 162:2333–2341

Wong CH, Weiss D, Sourial N, Karunananthan S, Quail JM, Wolfson C, Bergman H (2010) Frailty and its association with disability and comorbidity in a community-dwelling sample of seniors in Montreal: a cross-sectional study. Aging Clin Exp Res 22:54–62

Xue QL, Bandeen-Roche K, Varadhan R, Zhou J, Fried LP (2008) Initial manifestations of frailty criteria and the development of frailty phenotype in the Women's Health and Aging Study II. J Gerontol A: Biol Med Sci 63:984–990